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Claims

I claim:

1. A light-weight active mirror, comprising:

a first layer having a front side and a back side;

a second layer having a front side and a backside, the backside of the second layer faces the front side of the first layer;

a reflective surface on the front side of the second layer, the reflective surface operable to reflect desired wavelengths of electromagnetic radiation;

a plurality of electroactive actuator strips arranged between the first layer and the second layer and operable to alter a curvature of the mirror;

electrical connectors operable to cause the electroactive strips to alter the curvature of the mirror;

a plurality of stiffening elements interconnected with at least one of the first layer and the second layer and operable to stiffen the mirror; and

a plurality of shape retaining elements attached to at least one of the first layer and the second layer and operable to deploy the mirror and to bias the mirror in a desired position.

2. The mirror according to claim 1, wherein the first layer of the mirror comprises a polymer film.

3. The mirror according to claim 2, wherein the first layer of the mirror comprises a

2 kapton film.

1 4. The mirror according to claim 1, wherein the stiffening elements are arranged within
2 the first layer.

1 5. The mirror according to claim 1, wherein the stiffening elements comprise carbon
2 fiber rods.

1 6. The mirror according to claim 1, wherein the stiffening elements extend substantially
2 entirely across the mirror.

1 7. The mirror according to claim 1, wherein the first layer has a thickness of about 2 μm
2 to about 10 μm .

1 8. The mirror according to claim 1, wherein the first layer has a thickness of about 5 μm .

1 9. The mirror according to claim 1, wherein the second layer comprises a polymer film.

1 10. The mirror according to claim 9, wherein the second layer comprises a kapton film.

1 11. The mirror according to claim 1, wherein the second layer has a thickness of about 1
2 μm to about 5 μm .

1 12. The mirror according to claim 1, wherein the second layer has a thickness of about 2
2 μm .

1 13. The mirror according to claim 1, wherein the shape-retaining elements comprise
2 strips symmetrically arranged on and extending substantially entirely across the front side of the
3 first layer.

1 14. The mirror according to claim 1, wherein the shape-retaining elements comprise a
2 shape memory alloy.

1 15. The mirror according to claim 14, wherein the shape memory alloy comprises
2 NiTiNOL.

1 16. The mirror according to claim 1, wherein the electrical connectors comprise:
2 a plurality of negative electrodes attached to one of the front side of the first layer and the
3 backside of the second layer;
4 a plurality of positive electrodes attached to one of the front side of the first layer and the
5 back side of the second layer that the negative electrodes are not attached to; and
6 a plurality of contact pads attached to the front side of the first layer and the backside of
7 the second layer and electrically connected to the negative electrodes and the positive electrodes.

1 17. The mirror according to claim 16, wherein each electroactive actuator strip contacts
2 at least one contact pad on at least one of the top layer and the bottom layer.

1 18. The mirror according to claim 16, wherein the positive electrodes and the negative
2 electrodes comprise copper.

1 19. The mirror according to claim 1, wherein the mirror has a thickness of about 9 μm to
2 about 12 μm .

20. The mirror according to claim 1, wherein the mirror has a thickness of about 12 μm .

21. The mirror according to claim 1, wherein the electroactive actuators are operable to
2 correct induced vibration, deforming loads, phasing, and aberrations in real time.

22. The mirror according to claim 21, wherein the deforming loads comprise thermal
2 loads.

1 23. The mirror according to claim 21, wherein the aberrations comprise atmospheric
2 aberrations.

1 24. The mirror according to claim 21, wherein the aberrations comprise spacecraft
2 induced vibrations.

1 25. The mirror according to claim 1, wherein the electroactive actuators comprise at least
2 one of piezoelectric materials, polyvinylidene di-fluoride, copolymers of polyvinylidene di-

3 fluoride, lead zirconate titanate, and lead zinc niobate.

1 26. The mirror according to claim 1, wherein the electroactive actuators deform in
2 response to an applied voltage an amount proportional to the applied voltage and a D-coefficient
3 of the actuators.

Sub
A20
Cm
1 27. The mirror according to claim 1, wherein the electroactive actuators are addressable
2 individually or in groups.

28. The mirror according to claim 1, further comprising:
a wavefront sensing system comprising a plurality of sensors attached to or in close
proximity to the mirror and operable to sense an optical figure of the mirror;
signal processing controls operable to receive and process signals from the wavefront
sensing system and generate signals to control the electroactive actuators; and
feedback controls operable to receive signals from the sensing system.

1 29. The mirror according to claim 1, wherein the mirror has an average density of about
2 2 to about 5 grams per cubic centimeter.

1 30. The mirror according to claim 1, wherein the mirror has an average density of about
2 2 grams per cubic centimeter.

1 31. The mirror according to claim 1, wherein the mirror is space-based.

32. The mirror according to claim 1, wherein the reflective surface reflects visible light.

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